



URBAN WORLD ACTIVITY
MALARIA ACTIVITY 2:
THE MALARIA LIFE(CY)CLE,
PREVENTION & TREATMENT



Jane Goodall's
roots&shoots



MALARIA ACTIVITY 2:

THE MALARIA LIFE(CYCLE, PREVENTION & TREATMENT

This is the second activity in a three part series on malaria, each of which is designed to be completed in a single lesson. The activities can be treated as being completely stand-alone or carried out as a series. This particular activity is better suited to older students – groups of younger students may prefer to skip straight on to activity 3: effects of malaria and fundraising. They can all be downloaded from the Roots & Shoots UAE website at www.rootsnshoots.ae.

Despite some great advances over the past few years, malaria is still an everyday issue for many with 3.2 billion people across the world classified as at risk of infection by the World Health Organisation (WHO). In this activity your students will be learning about the lifecycle of the Plasmodium parasite that causes malaria. We also look at how a knowledge of the lifecycle can help to develop different classes of malaria treatment and prevention.

IN THIS ACTIVITY YOU AND YOUR STUDENTS WILL:

- ▶ Learn about the life cycle of the malaria parasite Plasmodium.
- ▶ Discuss how the life cycle can be disrupted to prevent or treat malaria.
- ▶ *Optional:* Create a wall chart about the malaria lifecycle to display at school, or add to the wall chart you created in activity 1.

OBJECTIVES

Carrying out this activity will help students learn about the life cycle of the malaria parasite *Plasmodium*, and how malaria can be prevented and treated.

WHAT DO I NEED TO MAKE IT WORK?

Access to the internet to do some background research and show some short videos. Should you choose to create one, you will need pens, paints or other craft supplies to make your wallchart.

WHAT THINGS WILL MY STUDENTS CREATE?

- ▶ *Optional:* A wall chart all about malaria.

WHAT IS MALARIA?

If you have completed the first activity in our malaria series (downloadable from the Roots & Shoots UAE website at www.rootsnshoots.ae) then you can skip this step.

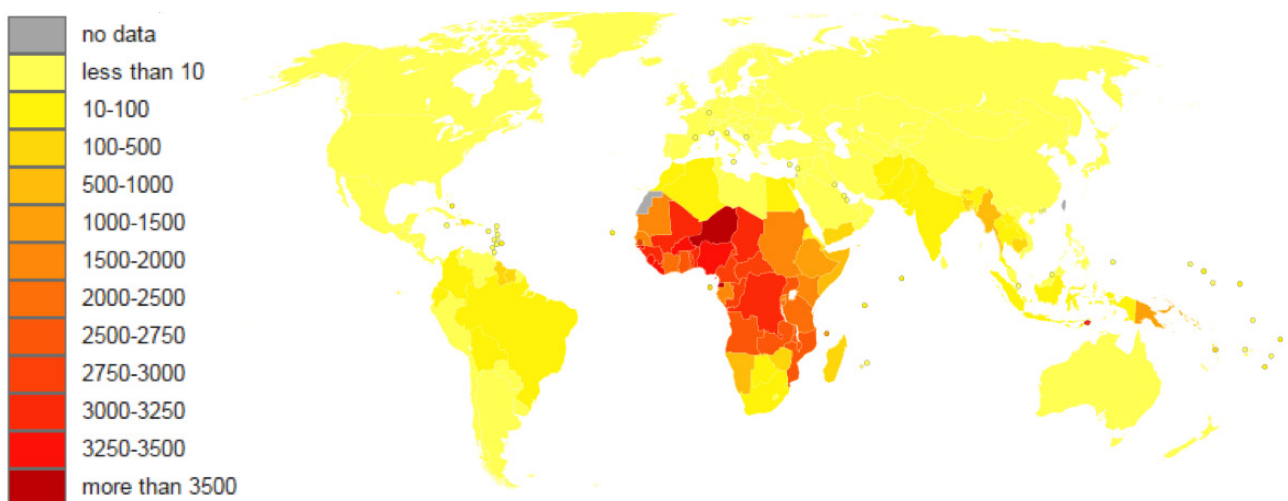
These are the key points about malaria that you and your students need to know to complete this activity.

- ▶ Malaria is a parasitic disease. It isn't like a cold or chickenpox (which are viral infections); or like a sore throat or bad stomach (usually bacterial).
- ▶ Malaria is spread by mosquitoes (specifically pregnant female *Anopheles* mosquitoes).
- ▶ According to World Health Organisation (WHO) estimates there were 198 million cases of malaria in 2013 which caused 584,000 deaths. Around 90% of the cases and deaths were in sub-Saharan Africa.



"Anopheles minimus" by Photo: James GathanyContent Provider: CDC – This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #7950. Licensed under Public Domain via Wikimedia Commons – goo.gl/oSu6kh

"MALARIA WORLD MAP – DALY – WHO2004" BY LOKAL_PROFIL



Licensed under CC BY-SA 2.5 via Wikimedia Commons – https://commons.wikimedia.org/wiki/File:Malaria_world_map_-_DALY_-_WHO2004.svg#/media/File:Malaria_world_map_-_DALY_-_WHO2004.svg

Darker colours indicate a greater number of people affected by malaria. The figures shown on the map and key are the disability-adjusted life year (DALY), which is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

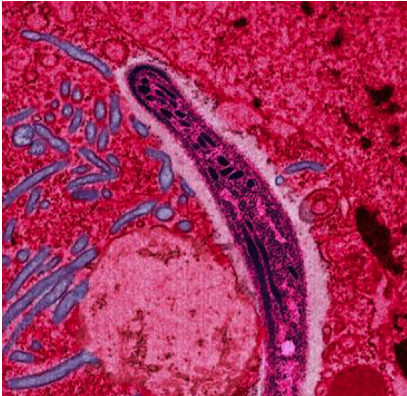
- ▶ **Children under the age of 5 are most at risk.**

FIND OUT MORE USING THESE LINKS:

- ▶ The WHO's malaria website: goo.gl/3x4W7V
- ▶ The WHO malaria factsheet: goo.gl/OjnbFq
- ▶ Malaria.com: goo.gl/vnCKuY
- ▶ Malaria facts video: goo.gl/syAjd6

THE LIFE(CYCLE OF THE MALARIA PARASITE

The malaria disease is caused by a parasite called *Plasmodium*. There are 5 species of *Plasmodium* which can infect and be spread by humans, with the most deadly form being spread by *Plasmodium falciparum*.



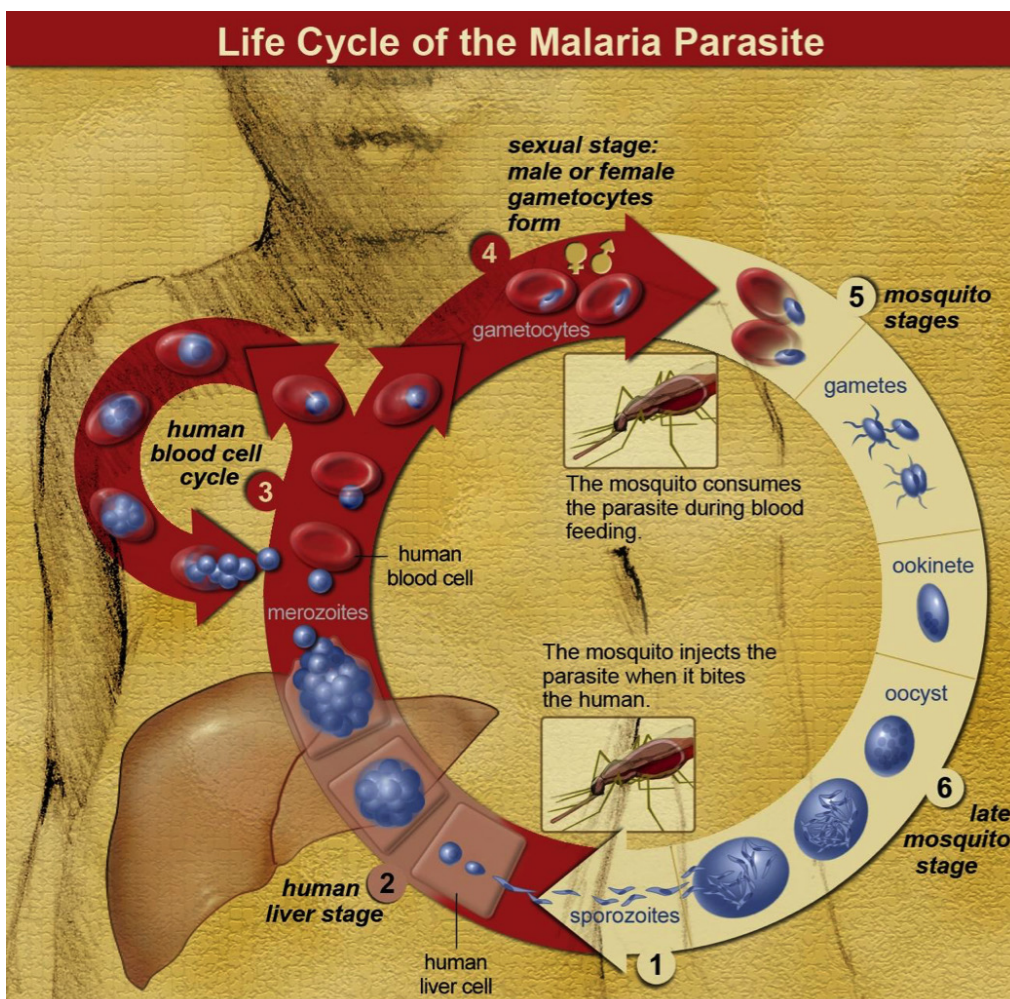
A Plasmodium parasite in mosquito saliva. Licensed under CC BY 2.5 via Wikimedia Commons - <https://commons.wikimedia.org/wiki/File:Malaria.jpg#/media/File:Malaria.jpg>

The *Plasmodium* parasite has quite a complicated lifecycle.

Understanding this lifecycle will help your students to understand how malaria can be prevented or treated.

The malaria parasite lives between humans and the *Anopheles* mosquito. Normally, mosquitoes are vegetarian. However, pregnant female *Anopheles* mosquitoes bite animals including humans to drink blood because it is high in nutrients. Most of these bites happen at dusk or overnight.

A simplified version of the lifecycle is as follows (numbers as per the diagram below):



"Life Cycle of the Malaria Parasite" by National Institutes of Health (NIH) - National Institutes of Health (NIH). Licensed under Public Domain via Commons - https://commons.wikimedia.org/wiki/File:Life_Cycle_of_the_Malaria_Parasite.jpg#/media/File:Life_Cycle_of_the_Malaria_Parasite.jpg

1. A **pregnant female Anopheles mosquito** infected with the **Plasmodium parasite** bites a human being. Parasites in the mosquito's saliva (in the **sporozoite** stage of life) pass into the human's bloodstream. From there they quickly migrate to the **liver**.
2. The sporozoites infect liver cells where they **reproduce asexually** creating thousands of **merozoites**. This causes the infected liver cell to burst, releasing the merozoites into the bloodstream.
3. The merozoites infect **red blood cells**, where they develop into ring forms, trophozoites and schizonts that in turn produce more merozoites, causing the red blood cell to burst and releasing them into the bloodstream. This can happen many, many times over and severely deplete the human's red blood cell count causing anaemia.
4. Rather than multiplying as described in 3, above, some of the merozoites in the blood cells develop into immature sexual (i.e. male and female) cells called **gametocytes**. These cannot mature inside a human being.
5. An as yet uninfected **pregnant female Anopheles mosquito** bites the human being and swallows the gametocytes along with the blood. The gametocytes then mature into **gametes** inside the mosquito's gut. These fuse (sexual reproduction) forming an **ookinete**.
6. The ookinete migrates to the outside of the mosquito's gut wall forming growths called **oocysts**. New sporozoites develop in the oocysts which then burst. The sporozoites then migrate to the mosquito's salivary glands where the cycle starts again at step 1.

You can find animated versions of the lifecycle with explanatory commentary on YouTube which you can show to your students. Here is a long version (7 minutes): [goo.gl/BqjeY0](https://www.youtube.com/watch?v=BqjeY0), a short version (just over a minute): [goo.gl/xJpKNA](https://www.youtube.com/watch?v=xJpKNA) and two videos from the Wellcome Trust with written explanations: [goo.gl/HtbNM7](https://www.youtube.com/watch?v=HtbNM7)

You can find a fuller version of the lifecycle to download and print here: [goo.gl/moyRgP](https://www.wellcome.org.uk/press/2015/05/27/malaria-lifecycle) - this version also contains information on where treatment and prevention can be targeted, which will be useful for the next step in this activity.

PREVENTING AND TREATING MALARIA

With an image of the malaria lifecycle up on a board/whiteboard, explain that stopping the spread of the disease is all about breaking the cycle of infection. We would recommend using the simplified version of the lifecycle as displayed in this activity here to avoid giving away too many details.

Ask your students at this point if, by looking at the life cycle, they can spot any places where the cycle could be broken and why. The product of this section should be a short list of prevention or treatment options, which can be used in part two of the activity. These could include:

- antimalarial drugs - these will help infected people recover by targeting and killing the parasite when it is inside them. These can break the cycle in either the liver or the bloodstream stage.

- ▶ Most antimalarial drugs target the bloodstream stage. The most effective is artemisinin-based combination therapy (known as ACT). goo.gl/wrwqmM
- ▶ Other drugs target the liver stage. This is mainly to treat relapsing malaria, when some parasites lie dormant in the liver and reactivate months or even years later. Primaquine is one such drug (goo.gl/fYyXbM).
- ▶ vaccines - a vaccine is slightly different from an antimalarial drug as it is designed to stop infection happening in the first place by making it impossible for the parasite to infect the liver. There is currently no vaccine for malaria, but scientists are working on these and one (called RTS) may even be available in 2016 (see goo.gl/c7Zn4p).
- ▶ mosquito nets - these prevent the mosquitoes biting and infecting people at night. Combined with insecticide, this is one of the most effective ways of reducing the spread of malaria. Mosquito nets are also very cheap to produce and distribute.
- ▶ spraying of insecticide - spraying around where people live to control the mosquito population decreases the chance of people being bitten and therefore infected.
- ▶ genetically modified mosquitoes - rather than targeting the parasite when it is in humans, you can target it in the mosquito. There is a lot of research going on into ways to genetically modify mosquitoes to be immune to the malaria parasite, breaking its lifecycle. See goo.gl/Vxnjvk
- ▶ habitat destruction - in the past malaria has been targeted through the wholesale destruction of the mosquitoes' habitat by draining swampland and treating areas with strong pesticides such as DDT. This was particularly effective in the USA (see goo.gl/SO32XG). However, such action is rarely taken today due to the negative effects this can have on other wildlife and plants.

BALLOON DEBATE

Divide your class up into a number of teams. Inform them that each team represents a different treatment or preventative measure, as produced above, and that they need to make their case to the government/funding body as to why their method is the best way to stop malaria. Allow them 10 minutes to prepare an argument, answering questions as they arise.

Each group will then have 2 minutes to put their case forward, with the rest of the class listening. The class can then ask questions for 1 minute. They may use images etc. if they have them available. Once all groups have presented, the class will vote on which method they support.

To finish, explain that a combination of methods is ideal, and that to do these correctly, a thorough understanding of the disease and its vectors is essential, so scientific research must be funded and conducted as well as direct prevention and control measures.

OPTIONAL: MAKE/EXTEND YOUR WALL CHART

Use what your students have learned, about the lifecycle of the malaria parasite and how to prevent/treat it to create a wall chart (or if you have already completed the first of our malaria activities then extend your existing wall chart). If you are intending to do the third activity in our malaria series then make sure you leave space for the wall chart to grow as the students learn more!

LEARN MORE

This activity is the second of three on the topic of malaria - the others can be downloaded from the Roots & Shoots UAE website at www.rootsnshoots.ae. In the first activity we looked at what malaria is and who it affects. In the third activity we will look at the effects that malaria has on communities in sub-Saharan Africa and show you some ways that you can raise money to help!

TELL US HOW YOU GOT ON

When your wall chart is finished, we'd love to see photos of it! If you already have an account you can upload a story with images to Roots & Shoots UAE (www.rootsnshoots.ae) and create an online gallery on the website. If you don't already have an account then just send us an email to MrH@rootsnshoots.ae and we can set you up.

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As well as the website at www.rootsnshoots.ae you can also find us on Facebook at <https://www.facebook.com/RootsnShoots.ae> or on Twitter as [@JaneGoodallUAE](https://twitter.com/JaneGoodallUAE)

WANT TO HELP IMPROVE THIS ACTIVITY?

This activity is a living document! Please help us by editing this activity to make it as good as possible. You can edit it by using this short link (just type it into your web browser's address bar): goo.gl/ck5EeJ - full instructions are provided. Any edits that can make this resource easier to use in the classroom or more applicable to life in the United Arab Emirates are very welcome, so please follow the link and make your contribution!